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Science in Cultural Borderlands: Methodological Reflections on the Study of Science, European Imperialism, and Cultural Encounter

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Abstract This article examines the methodological issues arising from the study of science and European imperialism. Drawing upon recent scholarship in a variety of fields, it argues for a combination of the concepts of "cultural borderlands" and "scientific imperialism" in analyzing the formation of science in cultural encounter. It also urges STS scholars to pay more attention to the field sciences. Although the focus of the article is on science and British imperialism in nineteenth-century China, its conclusions address an important aspect of the history of East Asian science, technology, and medicine from the early modern period to the twentieth century.

Chinese Abstract 本文審視研究科學與帝國主義一些方法論上的問題。 綜合近年來學術界對相關問題的論述, 本文嚐試從 "接境地帶" 和 "科學帝國主義" 兩個觀念出發, 探討文化遭遇情境中的科學實作及知識生產, 並強調田野科學在科學史上的重要性。 雖然本文以英國科學帝國主義在十九世紀中國為主軸, 其論點及方法對研究東亞科技及醫學在近現代的發展具有較廣泛的應用價值。

Keywords Borderland · Imperialism · Field science · Cultural encounter · Postcolonial studies

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In recent years, scholars in science studies and the history of science have paid increasing attention to field practices in science and no longer confine themselves to examining the traditional scientific establishment, experiments, and laboratories. In

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so doing, they take a broader view than before of the process of knowledge production, circulation, and appropriation. This shift of attention has helped to reveal the heterogeneity of scientific actors, the variety of sites for the making of scientific knowledge, and the complexity of negotiations among scientific actors. As a result, the lines between producers, users, and other various partners and interlocutors in science are no longer sharply drawn, and the sites of knowledge production are seen as diverse and not as limited to the scientific establishment.[1] In the meantime, the field has broadened its scope to include postcolonial studies, non-Western societies, and other global and comparative topics.[2] The historiography of European imperialism and colonialism has witnessed a change of perspective and emphasis. The traditional focus on the imperial structure and colonial administration has given way to interest in culture and knowledge in an imperial/colonial context and to a recognition of more reciprocal relations between metropole and colony. Moreover, scholars in a variety of fields have challenged Eurocentric historiography and proposed new approaches to the study of the modern world. No longer dividing the world into the West and the rest, they emphasize the interrelations among different regions and cultures, and consider the global condition as a whole. Recent studies on cultural encounter, the Atlantic World, maritime trade, migrations, etc. exemplify this new scholarship. One of their major tasks is to investigate intercultural encounters as complex patterns of contestation, transculturation, and collaboration (see, e.g., White 1991; Merrell 1999).[3]

These changes open up new opportunities and perspectives for scholars in science studies and the history of science. The conventional history of science maintains that modern science originated in European centers in the early modern period and, owing to its alleged intrinsic superiority over other forms of knowledge, spread to other parts of the world.[4] In more recent scholarship on science and imperialism/colonialism, this simple picture is sometimes modified to include the information flow from the colony to the European metropole. This model accepts that, in certain scientific research, the collection of raw data occurred in the colony, yet it also assumes that the information would subsequently be accumulated, organized, and analyzed in the metropole, where the crucial steps of knowledge-making are thought to have taken place. Both views neglect the fact that institutions and personnel distant from the metropole often played a pivotal role in the production of scientific knowledge. Not only did those in far-flung places gather information, but they also categorized, evaluated, certified, and conceptualized the information. Their activities in those places, therefore, deserve serious attention from science studies scholars. In fact, the web of science connecting colonies was as extensive and strong as those between metropole and colony. Naturalists in the colonies did not correspond only

[1]On science and fieldwork, see *Osiris*, vol. 11 (1996), *Science in the Field*.

[2]E.g., the special issue of *Social Studies of Science* 32 (December, 2002) on postcolonial technoscience. It must be emphasized, however, that much more along these lines is needed.

[3]For studies of transatlantic scientific encounters, see, e.g., Cañizares-Esguerra (2001), Schiebinger (2004), Barrera-Osorio (2006).

[4]The literature on science and empire is extensive. One may start with Adas (1989); Roy McLeod, ed., *Osiris*, vol. 15 (2000), *Nature and Empire*, which includes an extensive bibliography; and the "Focus: Colonial Science" forum in *Isis,* vol. 96 (2005): 52–87.

with the scientific establishment in Europe, but also with each other. The networks of scientific communications were therefore "polycentric" and "with multiple layers of authority and interaction" (Chambers and Gillespie 2000; Harrison 2005). It wasn't like a single wheel with the hub in, say, London and with the spokes pointing to India, China, Australia, Canada, South Africa, and the Caribbean; rather, the filaments of the web of science crisscrossed the globe.

Indeed, the production of scientific knowledge often depended on complex exchange and transactions between metropole and colony, between colonies, and among Europeans, creoles, and autochthons. Here, the concept of "cultural borderland" can be introduced to mark out the zone in which such exchange took place. In a cultural borderland, historical actors of different backgrounds interacted with each other and performed negotiations and transactions. The processes and outcomes of such encounters could range from conquest, conflict, friction, and cooperation to an assortment of mingling, hybridization, and blending. This concept thus allows more nuances and complexity in interpreting historical processes than does frontier, boundary, or any other similar notion that demarcates peoples or cultures and minimizes the importance of translation and negotiation. A cultural borderland refers to the space in which such actions took place. It doesn't have to be an actual physical or geographic space. It may be a discursive or symbolic space (say, in art and literature, when we talk about different styles or traditions of art or social customs that came together in a genre or in a social realm). Often, however, the geographic and conceptual spaces are related and should be studied in connection with each other, for one cannot properly understand a geographic place without considering the cultural meanings it embodies and vice versa. Because what is most interesting about studying borderlands (sometimes called "border studies") is the possibility of tracing the actual process of cultural encounter, one may do well to direct one's attention to cultural practice in action, on the spot, and in everyday life.

Although the concept of "cultural borderland" shares similarities in its purpose and function with that of "trading zone" and "contact zone," it is especially useful in treating the topic at issue.[5] The notion of "trading zone" relies too heavily on economic and sociolinguistic metaphors. There are encounters and exchanges that may not fit well with the ideas of trading and languages. In contrast, the notion of "contact zone" is comprehensive, yet it has the opposite disadvantage of being exceedingly general. It seems to include anything and everything that made up an encounter. I have therefore chosen to adopt the concept of "cultural borderland." I like the fact that the concept highlights two things. First, it draws attention to the cultural aspect (including material culture) of encounters, and, second, it maintains a sense of border and intermediacy. The first should be obvious. Most scientific activities can be studied with benefit as cultural practices. The second needs some explanation. While I very much emphasize the flexibility and contingency in the situation of a cultural encounter, I am aware that borders have existed. These borders were not fixed, and they were certainly not "natural." They were products of power negotiations. But we cannot ignore their existence, because they had real effects on historical actors. Moreover, I hold that it is necessary to recognize the historical

[5]On trading zone, see Galison (1997), ch. 9; on contact zone, see Pratt (1992).

function of so-called interlocutors, translators, and go-betweens, who operated in the cultural borderland and mediated between the parties. They frequently played significant, though often neglected, roles in the history of science.[6]

What can we learn from these new methodological considerations? How can we make use of them in the study of knowledge and empire, science and cultural encounter, and other related topics in the context of Sino–Western relations in the late eighteenth and the nineteenth century? Reflecting on these issues and drawing mainly upon my research on British naturalists in Qing China, I want to achieve a couple of goals in this essay (Fan 2004).[7] First, by examining scientific practice in cultural borderlands, I intend to provide a history of science and empire that departs from the metropole-centered view. I shall demonstrate that there are good reasons to examine the history of natural history (and, indeed, the history of many other field and environmental sciences) from the perspective of cultural encounter. I believe that if we want to better understand certain areas of scientific inquiry—for example, geography, geology, anthropology, archaeology, meteorology, and natural history—in the eighteenth and nineteenth centuries, it is important to take the issue of cultural encounter seriously. These areas of inquiry depended heavily on fieldwork or environmentally situated research, and they developed in connection to cultural contacts in many parts of the world. By foregrounding the issue of cultural encounter, we will be able to examine a crucial, but hitherto neglected, aspect of the development of these sciences.

Second, I hope to show how this perspective and approach may contribute to our understanding of science in China during this period. In line with my discussion of cultural borderlands, I will focus on the everyday scientific practices of British naturalists and their local associates in China. This approach differs substantively from the traditional historiography of Chinese science, which explicitly or implicitly contrasts the Chinese knowledge system with "Western science," and places the history of Chinese science within the global social, political, and economic context. Rather than starting from rigid cultural categories (such as Chinese/European, East/West), we trace the circulation, translation, and generation of knowledge in cultural borderlands, where identities and cultural categories were often contingent. I would also like to draw attention to the range of historical actors involved in the production of scientific knowledge. British naturalists in China included traders, missionaries, medical doctors, army officers, gardeners, plant hunters, traveling naturalists, and consular officers. They had contact with Chinese from all walks of life: officials, merchants, herbalists, compradors, servants, artists, craftsmen of different trades, fishermen, gardeners, interpreters, street peddlers, casual laborers, peasants, and hunters, among others. In this essay, I cannot discuss more than a few of these diverse groups. I believe, however, that even a limited sampling will be enough to

[6]The idea of borderland has been taken to task for focusing too much on the margins. See the forum, Entangled Empires in the Atlantic World (2007). Borderland history certainly has its limitations, but, nevertheless, it is still a powerful interpretive framework for understanding knowledge production and transmission in cultural contact.

[7]Bretschneider (2002), originally published in 1898, remains indispensable as a mine of biographic information. Although this paper focuses on natural history, many of its observations also apply to Western medicine and imperialism in China. See, e.g., Li (2006, 2007).

suggest a different picture of the history of science from one that features the more traditional scientific groups, disciplines, and activities.

Finally, focusing on cultural encounter in the history of science will suggest new research directions, yet it will also pose certain methodological difficulties. Some of these difficulties arise from the limitations set by the available historical records—the gaps in historical documentation that often plague research into the history of science in cultural contact; others are methodological. I shall consider some of these issues in the last part of this essay.

Naturally it is impossible to do justice to all these avenues of inquiry. I can only sketch out in broad strokes a few arguments and historical examples, some of which, I hope, will encourage more research on science in cultural borderlands in East Asia.

2

The traditional historiography of European science centers on mathematics, astronomy, and the physical sciences. This focus leaves out one of the most extensive areas of scientific research in the early modern period. Surely, if anything, natural history, especially botany, should be seen as the "big science" of the time. It enjoyed enormous attention and support from scientific bodies, government offices, maritime enterprises, and colonial administrations. It was no coincidence that a botanist, Joseph Banks, presided over the Royal Society for decades and was hailed as the Newton of his time. He was the most powerful man in British science in the late eighteenth and early nineteenth centuries and maintained close connections to the Royal family, the British government, and the English East India Company. In this respect, Britain was no exception. Natural history was equally popular in other major scientific nations and imperial powers, such as France and the Netherlands. In order to understand British scientific research in China, two aspects of this phenomena deserve special consideration: first, the widespread popularity of natural history in European societies and, second, the interrelations among natural history, imperial expansion, and maritime trade.[8]

In eighteenth- and nineteenth-century Europe, natural history was a science and a cultural fashion popular among the public. This was expressed in the vogue for science lectures, botanizing, fossil hunting, and shell collecting, among many other pursuits. The Europeans carried this fascination for natural history with them when they went abroad. Consuls, travelers, missionaries, army officers, and merchants were often also ardent and competent naturalists. In the seventeenth and eighteenth centuries, employees of the maritime companies constituted a major pool of talent for natural historical research in the outreaches of the European powers. Before the middle of the eighteenth century, scientific voyages and explorations were relatively few. Thus, it was the network of maritime trade that supplied Europe with most of its scientific data about the rest of the world. It is important to bear in mind that what appears to have been the "mere" collecting and transmitting of scientific information

[8]The literature on the history of natural history is sizeable. Two convenient points of entry are Jardine et al. (1996) and Allen (1994).

actually involved active cognitive processes of surveying, interpreting, evaluating, classifying, and certifying observations and objects according to local environments. The continued existence and expansion of European overseas trade was largely dependent on scientific expertise and material practices—sea charting and mapping, of course, but also investigations into trade items, most of which were products of plants and animals. This nexus of knowledge and trade goes a long way towards explaining the geography of knowledge production and circulation on both regional and global levels. Global trade fostered the growth of maritime entrepôts: Amsterdam, Antwerp, Seville, Lisbon, London, Liverpool, and Marseilles in Europe; Goa, Bombay, Calcutta, Malacca, Batavia, Manila, Macao, Canton, and Nagasaki in Asia; the Caribbean islands in the Atlantic; and so on. These port cities, girdling the globe, held the lifelines connecting the oceans and continents; they also became major sites for scientific research and major hubs for the circulation of knowledge (see, e.g., Schiebinger and Swan 2004; Cook 2007).

This macro-perspective of global trade should be complemented by a micro-view of the day-to-day scientific practices in cultural encounter, for cultural encounter always took place in a particular place and time and in a particular social and cultural environment. Thus the best way to study a field science is to put it in *place*, so to speak.[9] In the case of a maritime entrepôt, we can view the city as a site of fieldwork, a nodal point of information exchange, and a borderland of cross-cultural encounters. This approach emphasizes trade as an integral part of scientific work in the multiple social and physical spaces of an entrepôt. Entrepôts depended for their survival on contacts, encounters, and transactions among people from places and cultures far apart. European traders in non-Western societies did business with the people there, buying and selling goods, establishing commercial networks, extending social relationships—and sometimes collecting scientific specimens. The natives engaged in trade also acted as cultural agents and transmitted knowledge they considered valuable to their own societies. The flow of natural historical data mingled with the flow of goods and currency. To some extent, in fact, plants and animals themselves became a means of monetary and social exchange and acquired multiple kinds of value at once: economic, social, aesthetic, and scientific. Science as cultural practice in an entrepôt was thus embedded in the trading city's international character.[10]

During this period, the largest entrepôt of China was Canton (Guangzhou), whose major trade partners included Britain, which secured predominance in the China trade by the last quarter of the eighteenth century. British traders in Canton consisted of the employees of the English East India Company (which had the official monopoly on the British–Chinese trade until 1834) and some independent merchants. In the trading season, there could be hundreds of foreign traders and sea captains in the port of Canton.

The long European fascination with Chinese gardening and horticulture defined the primary goal of the British naturalists' research. It was to garden plants,

[9]For a general introduction to the topic of science and place, see Livingstone (2003).

[10]Science in the entrepôt can be seen as one particular scenario of the general subject of science and the city. For two recent treatments of the subject, see *Osiris*, vol. 18 (2003), *Science and the City* and Gieryn (2006).

horticulture, economic botany, and related subjects that they devoted their attention. The urban environment of Canton turned out to be ideal for this area of research. Behind the hustle and bustle of a trading city lay a fertile field of scientific inquiries. The members of the Canton Factory of the English East India Company played a significant role in the investigation of China's natural history, because many such inquiries required systematic and sustained efforts that only residents in Canton could carry out. The horticultural and botanical establishments in Britain recognized this situation and formed a rapport with members of the Factory. Kew Gardens, the Linnean Society, the Royal Horticultural Society, and the Zoological Society of London were among the active supporters of British trader-naturalists in Canton.

The success of the scientific research of British residents in Canton often hinged on their activities in trade and everyday life. Unlike transient visitors, residents had access to logistics, street smarts, and other capacities derived from years or decades of residence in a Chinese entrepôt to facilitate their research. Thus, they formed a crucial link in the investigations into the natural history of China. In the first decades of the nineteenth century, for example, the British residents in China who played an instrumental role in natural historical research included: George Thomas Staunton, a correspondent of Joseph Banks; John Livinstone, a surgeon to the Canton Factory; George Vachell, the Factory's chaplain; and John Reeves, a tea inspector and probably the most active British naturalist in China before the Opium War.

Since Westerners in Canton faced strict rules that limited their activities and confined them to a narrow district of the city, the naturalists rarely went farther on their expeditions than the gardens, nurseries, fish markets, drugstores, and curio shops in the district. Thus, the fieldwork sites of British naturalists in Canton were primarily located in the markets. This might seem idiosyncratic to the modern reader, but, in fact, seeking scientific specimens and information at the marketplace was a common practice among European naturalists in Europe as well as in other parts of the world. In Canton, the shops and vendors in the few streets in the neighborhood of the Factories and the Huadi nurseries, a few miles upstream, supplied most of the specimens—including birds, mammals, fish, insects, garden flowers, fruit trees, and materia medica—the naturalists sent home. In addition, Westerners in Canton frequented the Hong merchants' splendid gardens, where rare flowers not available in commercial nurseries, such as the best varieties of the tree peony, were to be found. British naturalists were so impressed with the Hong merchants' contributions that they named a shrub after Conseequa (Pan Changyao of the Liquan Hang).

Introducing a new plant involved much more than making a new find, however. A successful transplantation required a package of data and practical knowledge about the plant. Soil, humidity, water, temperature, timing, light, preservation, and transportation, and a welter of other factors came into play; vital information was needed to ensure the survival and health of the plants. The information and descriptions of flowers recorded in China helped botanists in Britain keep the plants alive, determine by comparison if they were growing properly, and cultivate different varieties. The gardeners sent by the (Royal) Horticultural Society to Canton in the 1820s certainly knew this routine. During the months they were in Canton, they worked with the local British naturalists, who took them to the flower nurseries and gardens. There, not only did the British gardeners select plants for shipping home, but they also observed and noted down how the Chinese gardeners grew and

managed the plants. They did not always agree with what they saw, yet they took what they learned from the Chinese seriously. They understood that this knowledge would be useful to the cultivating and breeding of the plants in England. In fact, the British frequently followed the Chinese classification in horticulture and preserved (though usually renamed) the varieties of roses, azaleas, chrysanthemums, tree peonies, tea flowers, and other plants.

From this brief discussion of science in the entrepôt of Canton, we may make a few observations. In the early modern period, the enterprise of natural history (and many other branches of science) often intersected with European expansion and global trade. With the help of their Chinese associates, such as the Hong merchants and the local nurserymen, British naturalists in Canton effectively reconfigured the entrepôt, turning it into a site of knowledge exchange and production; urban and commercial practices in everyday life were transformed into powerful research tools and techniques. A regular fish or flower market became a site of scientific investigations. In the borderland of an entrepôt, British naturalists in China pursued scientific research by broadening the already established friendships, commercial relationships, and similar modes of exchange. Horticulture and natural history became part of the circulation of aesthetics, information, wealth, goods, and other cultural productions in a global trade network facilitated by the British maritime empire.

Until the first decades of the nineteenth century, the British Empire did not hold domination over Qing China even on the coasts, and their relationship was based solely on trade. This power balance shifted against China after the Opium War, especially after the 1850s–1860s, when the Qing state was greatly weakened by both internal and external pressures. The more aggressive kind of Western imperialism made its impact in East Asia. Responding to the change of broad political conditions and scientific developments, natural historical research in China entered a new phase.

3

In the second half of the nineteenth century, natural historical research broadened to include the interior of China. This process was inseparable from the expansion of British imperial power in China, but it was also connected to the Chinese efforts to deal with this challenge. We can identify three prominent aspects of natural historical research in China during that period. They are: (1) the expansive institutions of British informal empire in China (such as the British Consular Service, the Chinese Maritime Customs, and various commercial and missionary establishments) which played a role in assisting and shaping natural historical research; (2) the intertwined development of sinology and natural history in the Western community in China—which directly involved Chinese translators (although, with a few exceptions, it is difficult to trace who they were and what they actually did in the process); and (3) the increasing opportunities to do fieldwork in the interior and the effects of this on certain branches of natural history, such as biogeography and situated knowledge in fieldwork. Since the focus of this paper is on natural history as a field science, I will pay more attention to (1) and (3) than (2).

In our discussion of Canton, we used the interpretive concept of cultural borderland to explain the encounter of the British naturalists and their Chinese associates in the social and cultural environment of an entrepôt. The risk involved in using the concept of cultural borderlands too casually is that it might downplay the reality of power differentials. Although this implication is not intrinsic to the concept, there is still the possibility that it might invoke a rosy picture of free exchange of cultural productions. Therefore, we should increase the emphasis on scientific imperialism in explaining British research after the early nineteenth century; scientific imperialism was correlated with the expansion of British imperialism in China. As an interpretive concept, scientific imperialism stresses the symbiotic, even integral, relationship between scientific and imperialistic enterprises. It insists that scientific development and imperial expansion can be best understood as interactive components of a feedback loop. The development of geography, for example, was built partly on imperial imagination, apparatus, and expansion, which in turn drew upon geographic knowledge for support.[11]

After the Opium Wars, the Western powers gained strongholds in the treaty ports and extended their tentacles of power into the interior of China. During this period, the cohort of British naturalists in China consisted of the employees of the British Consular Service and the Chinese Maritime Customs. The missionary organizations and the merchant class also provided talent and infrastructure for natural historical research. Between the 1840s and the 1890s, the British Consular Service in China employed more than 200 officers, excluding lesser employees and the many Chinese clerks. By 1880, they had opened consular offices in more than 20 cities. The Chinese Maritime Customs was a government agency of China, founded in 1854 to run the maritime customs at the treaty ports, but its officers, from the inspector-general down, were mostly British. In the 1890s, the Customs had about 700 Western officers of different ranks; significantly, more than half of them were British.

These non-scientific organizations outstripped any scientific bodies in supplying talent for research into the natural history of China. The botanist Henry Hance was a consular officer, so was the zoologist Robert Swinhoe. Augustine Henry, a botanist, was a Customs officer. One can easily name another score of government employees who seriously pursued natural historical research during their careers in China. Only French missionaries, who had their own network and enterprise, and Russians, who had unique access to the northern and northwestern parts of the Qing empire, contributed as much.[12] Energetic and educated, junior members of the British

[11]The central focus of the current literature on scientific imperialism has been science and imperial domination; so, much scholarship tends to dichotomize and essentialize power relations between the West and the rest. Scientific imperialism is a useful concept. It acknowledges the reality of power differentials (in particular contexts) and helps to foreground the purposes, organizations, and ideas of the enterprise of science in European expansion. But if we want to know how scientific activity unfolded in the colonies and in non-Western parts of the world, we cannot ignore the indigenous people, their motivations, and their actions in the historical process.

[12]Dumoulin-Genest (1994); Mau (2007); Bretschneider (2002). For a comparative study of French and British efforts in acclimatization, see Anderson (1992).

Consular Service and of the Chinese Maritime Customs could make ideal naturalists. Their positions also provided them with means and opportunities for gathering scientific data. Overall, the administrations of the Chinese Customs and the British Consular Service supported the scientific activities of their members as long as the regular official work did not suffer. In fact, their official work sometimes included scientific investigations.

Naturalists whose reason for being in China was not primarily scientific—civil servants, missionaries, and merchants—used research methods that depended on, and were determined by, their duties. Both the Consular Service and the Maritime Customs, for example, reshuffled their staffs frequently, and their officers were transferred from station to station every few years, sometimes more than once a year. This internal institutional policy strengthened the naturalists' networks and furthered their information collecting. It provided them with mobility, social contacts, and promising new fieldwork sites. Frequent transfers also promoted the social contact and private networking among the officers. In the course of his career, an officer could establish friendships with many colleagues who also moved from place to place, and could thereby forge an extensive network of correspondence across much of China.

Parallels can be drawn between them and the trader-naturalists in Canton. Both groups included very few naturalists by vocation. The majority devoted their spare time from other lines of work to the pursuit of scientific interests. To that end, both groups successfully mobilized their social positions, personal networks, institutional resources, and professional skills. They turned existing social, commercial, and political networks into means for the production of scientific knowledge. In discussing British naturalists in Canton, I suggested that trading enterprises like the East India Company should also be seen as enterprises of knowledge production. Similarly, I want to argue here that it was no coincidence that British naturalists could conduct some of their scientific work through diplomatic and political organizations. This is because, in certain crucial ways, the British Consular Service, the Chinese Maritime Customs, and the commercial and missionary establishments, too, were enterprises of information gathering and knowledge production.

One of the major components of scientific imperialism was the ideology and practice of collecting information and producing knowledge—knowledge that claimed to be factual, objective, scientific, and definitive—about other parts of the world. The best example of this attitude may be found in the management of the Chinese Maritime Customs, which was a Western-style institution, headed and run mainly by Westerners, but which belonged to the Qing government. The British insisted on having the right to manage the institution because they claimed, and believed, that the Chinese could not do it right. Robert Hart, who headed the Customs for many decades, instructed his office to publish a series of impressively detailed statistical studies on important items going through the ports, including Chinese drugs and other animal and plant products. In the same vein, they also put out volumes of scientific studies on silk, fisheries, public health, and so on. These volumes were compilations of reports sent by the officers from every treaty port to the headquarters. The officers evidently had made diligent efforts to collect, classify, and analyze the data. Claims to factual accuracy were manifest in the form and content of these publications: multiple-column tables and statistics, translated from

Western practice, filled many of the volumes.[13] They deemed they could produce useful, scientific knowledge from the information and that the knowledge would eventually bring material benefits to the Chinese. Although natural historical research was conducted mainly outside of the naturalists' official capacity as consular or customs officers, it corresponded to a similar ideology of scientific imperialism and scientific commonweal.

However, the naturalists could hardly conduct scientific research on their own. In order to accomplish the tasks they set out for themselves, they often needed the help of the natives. Thus, just as the trader-naturalists in Canton tapped their commercial connections, these naturalists recruited local Chinese officials, merchants, herbalists, and others through official channels or personal networks. One of the most salient aspects of their research was fieldwork. We (historians of science) often underestimate the importance of fieldwork in natural history (and in other branches of science), partly because we are academics and tend to undervalue knowledge that doesn't come from book learning or laboratory experiments. In fact, fieldwork was crucial to natural historical research. It was the only way to collect large numbers of specimens and to determine precisely the origins of these specimens. It was the only way to survey or map the flora and fauna of a particular location. Moreover, some scientific knowledge about plants and animals could only be gained from field observations: the habitat and behavior of a particular kind of animal, the seasonal change of flora and fauna, or migratory patterns of birds, to name a few. We can say that fieldwork laid the groundwork for mapping the natural environment of a region—in this case, China. Here, natural historical research merged with the general enterprise of collecting information and presenting "scientific," "objective" knowledge of a region. The power to collect, to travel, and to represent cannot be separated from the power to impose one's will and one's regime of knowledge. Fieldwork, in this view, was scientific imperialism at work.

Fieldwork is important to our understanding of scientific imperialism, not simply because it was crucial to natural history research, but also because it was a site of power negotiation and knowledge translation, and thus provides a window on scientific imperialism in action at the level of micropolitics in everyday life. Natural history research required constant negotiations between the naturalists and the natives they employed, and between the naturalists and the local population. The distribution of power in fieldwork relations did not necessarily favor the naturalists, even in the colonies. The naturalists were highly dependent and vulnerable in unfamiliar places. In China, their control over the circumstances of fieldwork was even more tenuous. However much troubled by foreign aggression, China was never colonized by Western powers, and British naturalists on expeditions in China did not enjoy the direct support and protection of the British imperial apparatus. A good personal and working relationship between naturalist and Chinese employee was vital to successful fieldwork. In pursing fieldwork, the naturalists typically hired native guides and collectors and invariably sought assistance from the local people,

[13]It may be argued that, in the end, both the Qing and the British government appropriated the institution. Our main concern here is the ideology that underlay the character and the management of the Customs. For a recent treatment of the topic, see the special issue of *Modern Asian Studies* on Robert Hart and the Chinese Maritime Customs, *Modern Asian Studies* 40.3 (2006).

who possessed unique information about the plants and animals of the place. For inquiries into economic botany, reliance on the Chinese locals was of paramount importance. They controlled the supply of trade items and they knew what plants and animals the products came from and where those plants and animals could be found. The investigations required more than simply identifying the origins of the products. It was also necessary to find out the methods used to process and refine them. So, just as in Canton, the Chinese occupied certain critical links in the network of knowledge production (more on this in the next section).

To sum up: British imperialism in China was hardly limited to commercial aggression backed up by gunboat diplomacy. It also corresponded to the expansion of a cognitive regime based on a will to know, a confidence in certain forms of knowledge, a desire to export "universal" values, and a belief in the common good it envisioned. This lofty vision of scientific imperialism allowed little room for the natives' wishes. Yet, scientific imperialism had to be carried out on the ground, in everyday activities, and along the matrix of human relations. As we have seen, fieldwork in natural history provided a point of entry for explorations into the day-to-day practices of scientific imperialism in cultural borderlands. Once we get to the ground, so to speak, we see that the pattern of power relations was complex, dynamic, and localized. It involved constant negotiations among different parties, and the outcome was not uniformly in favor of the naturalists. In a way, it was a situation of "dominance without hegemony."[14]

4

We have examined certain salient aspects of the history of science, imperialism, and cultural encounter in China from the mid-eighteenth through the nineteenth centuries. Our focus was selective, concentrating on natural history, science in the field, and British–Chinese contact. Yet, many of our insights may be broadly applicable. Plenty of evidence shows that British naturalists in other non-Western societies often found themselves in situations comparable to those described above. As regards China, I suspect that one can adopt a similar approach to the study of its interactions with other Western imperial powers in the country: France in southwestern China and Russia in the northwestern part of the Qing Empire.[15] To some extent, one can also examine Japanese scientific imperialism in Manchuria in a similar light. Of course, as in any comparative history, modifications have to be made to account for historical specificity in each of these cases.

[14]I am taking this phrase from Guha (1998).

[15]In China as well as in many other parts of the world, Western naturalists of different nationalities had complex relationships with one another. On the one hand, there was a degree of national and imperial competition between them. On the other, there were certain bonds that tied them together, notably scientific brotherhood and a foreign and Western identity (vis-à-vis the natives). Usually, British naturalists maintained collegial relationships with other Western naturalists in Qing China, and they assisted each other. For instance, when British naturalists traveled to southwestern China, they sought help from French missionary-naturalists in that area.

In this section, I would like to step back and reflect on a few questions involved in studying science in cultural encounter. The main issue I want to talk about is the problem of "asymmetry." When we study science in cultural encounter, especially regarding the field sciences, we often face the problem of asymmetry or imbalance in historical documentation, scientific exchange, and power relations—a frequent problem in dealing with the encounter between Western and non-Western societies. This is not an intrinsic problem to the study of cultural encounter, but it is often a challenging one. Even in the case of China, which is probably better than most, the historical documents are asymmetrical, and it is hard to uncover the historical agency of the Chinese involved in field research—their intentions, motivations, actions—in the encounter. Of course, this problem is not unique to our topic. It haunts every historian who tries to recover people lost to history—be they Amerindians who perished in the European conquest, Italian women in witch trials in the sixteenth century, or Indian peasants in the nineteenth century. Historical sources are indirect and often limited. We always know more about one side of the story than the other; what we know about these peoples has come mainly from the words of the conquerors, the prosecutors, and the administrators—that is, the dominant and the articulate. Ethnohistorians (e.g., James Axtell), microhistorians (e.g., Carlo Ginzburg), practitioners of subaltern studies (e.g., Ranjit Guha), as well as anthropologists have tried to develop approaches for capturing muted voices from the remains of the past. Whatever reservations one may have about their methods and claims, their efforts are laudable and inspiring (e.g., Axtell 1981; Ginzburg 1992; Muir and Ruggiero 1991; Guha and Spivak 1988).

As far as I know, British naturalists in China did not actually meet, in a significant way, Chinese scholars who were particularly learned in traditional "natural history." This largely rules out the kind of scientific exchange we all hope to find: two or more learned scholars discussing grand ideas in a book-lined study, in correspondence, in public debates, or in learned treatises. As historians, we all hope to have enough relevant sources to reconstruct the process of exchange and to analyze the translation of ideas. Regarding China, for example, excellent work has been done on the intellectual exchange between the Chinese and the Jesuit scholars in the seventeenth and eighteenth centuries, mainly about mathematics and astronomy, by making use of such sources. In the nineteenth century, Western sinologist-naturalists did utilize Chinese texts on plants and animals to facilitate their scientific research, and they sought assistance from their Chinese associates in locating and interpreting relevant descriptions in the texts.[16] It is not easy, however, to determine who the Chinese were, what they did, and how the translation was carried out.

And conversely, in the last decades of the nineteenth century, more and more Chinese had contact with Western natural history through magazines, translated texts, and school education. This is a promising area of research; it also fits well with the current interest in the translation and introduction of Western learning into late Qing China. In this important trend, some scholars have approached the topic along the line of intellectual history. Others have concentrated on the transliteration of

[16]Fan, *British Naturalists in Qing China*, ch. 4.

terms. In natural history, the best known translation is Li Shanlan and the missionary Alexander Williamson's co-translation of John Lindley's botany textbook in 1858. The Chinese title of the book *Zhiwu xue* has become the Chinese name for botany, and some of the botanical terminology introduced in the text is still in use. This episode has been examined by Chinese scholars and the French sinologist Georges Métailié (e.g., Xiong 1994; Wang 1991; Jin and Liu 2000; Pan 1993; Métalié 1981; Shin 2000). The authors, however, have focused narrowly on the translation of the botanical terms. (This is understandable, because other than the texts themselves, there are few sources directly related to this translation.)

Although I wish to see more research on scientific exchange among the learned, I must again plead for attention to another, less noticed, kind of scientific encounter. Natural historical research was mainly conducted through informal and private transactions, and most of the Chinese involved were socially lower people who left few traces in historical records. An exclusive focus on the translation of texts is not likely to tell us much about fieldwork, taxidermists, collectors, museum practices, artisanal skills, and other people and knowledge that were indispensable to natural historical research. We would then be leaving out a big chunk of what was considered important by eighteenth- and nineteenth-century naturalists. Once we turn our attention to cultural and material practices in science, we will notice numerous circumstances in which naturalists and Chinese encountered and interacted with each other. We will see that exchange occurred in broad scope, at different levels, and in unexpected spheres. The naturalists had transactions and interactions with Chinese from all sorts of backgrounds. Moreover, these transactions were crucial to the generation, translation, and circulation of knowledge in natural history. Let me give two examples.

First, we mentioned above that during the time of the Canton trade, British naturalists eagerly sought garden plants in Canton and learned from their Chinese associates (mainly gardeners, tradesmen, and merchants) horticultural lore and other knowledge useful to natural historical research. Similarly, the British often hired local draftsmen to draw natural history illustrations. Most of the specimens they collected could not survive the transoceanic voyage, so these illustrations became crucial scientific information. The scientific collaboration went as follows. British naturalists in Canton selected the plants and animals they deemed interesting and significant and hired Chinese draftsmen to draw them under their supervision. The Chinese draftsmen supplied the artisanal knowledge, skill, and observational power necessary for the precise depiction of the specimen. With these illustrations, the scientific establishment in Britain described and classified the varieties or species. Now, the relationships among the three partners were not equal in terms of their positions in the established system of scientific importance, credential, and hierarchy. Usually, major figures well placed in the scientific center had more voice and prestige than minor naturalists abroad. It should be noted, though, that because of their first-hand knowledge of the place, the naturalists abroad did not always bow to the authority of the scientific metropole. They often could hold their own, and

their opinions on the local flora and fauna were taken seriously. The Chinese draftsmen, in this case, played the role of "invisible technicians" in science.[17] They did their part and disappeared. However, if we see science as cultural practice and if we pay more attention to neglected participants in the production of scientific knowledge, we will see the structure and process of knowledge-making in a more sophisticated way. In laboratory science, for instance, laboratory technicians often possessed know-how that was instrumental to successful experiments. Without their expertise, experiments would go nowhere. The Chinese draftsmen occupied a similar place in the history of science.[18]

In order to understand how this collaboration was possible, it is necessary to place it within the context of the China trade. The Chinese draftsmen had long practiced in Chinese export painting, whose style was a mixing of Chinese genre painting and European "realism" (the use of perspective, light and shade, etc.). Export painting was the collaborative outcome of Chinese artisans and European customers; it was created specially for the European taste and market. Interestingly, the painting was perceived in Europe as Chinese-style painting, but it was taken to be Western-style painting in China itself. (This should make us hesitate to call something European or Chinese too quickly. Much of European taste in art, horticulture, and natural history was a product of global contact.) It is not easy to gauge the direct impact of the scientific drawings done by Chinese draftsmen on European natural history illustration, but it seems that they were not widely circulated. It is probably true, too, that the Chinese draftsmen who were involved in the collaboration did not have many opportunities to apply their newly acquired knowledge and techniques to Chinese scholarly books on plants and animals. Nevertheless, these natural history drawings constituted an important medium of scientific communication and were part of a broad exchange of taste, ideas, aesthetics, material culture, and plants and animals. Indeed, the drawings can be seen as a site of cultural encounter or a borderland in which different cultures—European and Chinese, art and science—converged. This example helps us to see the enterprise of natural history in a different light. Natural history, in this case, was part of the intersecting realms of art, science, and commerce, and we cannot understand it properly if we put it in a narrow or truncated framework. Chinese artisans and European naturalists both participated in the production of knowledge and material culture in natural history.

Take another example: fieldwork and folk knowledge. As has been explained, fieldwork was a central part of nineteenth-century natural history. Much of the

[17]The concept of "invisible technicians" can be found in Shapin (1994), ch. 8. How the system operated has contemporary relevance. On the contemporary issues of biopiracy, intellectual property, and benefit/credit sharing in a global context, see, e.g., Hayden (2007); Adams (2002).

[18]For more on this example, see Fan, *British Naturalists in Qing China*, ch. 2. For a general account of export painting in Canton, see Jiang (2007). For an extensive account of science and artisanal knowledge in seventeenth-century Europe, see Smith (2006).

knowledge in natural history was produced in the field, in a foreign place, through negotiations with the natives; that is, in a cultural borderland. Traveling naturalists rarely stayed in one place long enough to become fully familiar with its flora and fauna. Since nobody was more familiar with the local plants and animals than the people who lived among them and observed them daily, the naturalists drew on their expertise. Without folk knowledge from the locals, the naturalists could not accomplish much. They could not find the more elusive animals, nor could they figure out the habits, behaviors, seasonal change, etc. of the local plants and animals—elements crucial to the composition of a satisfactory picture of the local flora and fauna. In fact, this kind of local knowledge was crucial to any field science. In natural history, you see such knowledge recorded in field notes, reports on fieldwork, descriptions of the local fauna, and other similar kinds of science writings. By including the native associates and folk knowledge in the picture, we uncover a neglected but prominent aspect of natural history. Although the naturalists necessarily exerted their authority in determining what was reliable and what was worth reporting to the scientific community, thereby policing the boundaries of science, they were frequently forced to leave the matter largely unresolved. The resulting knowledge, straddling between science and folk knowledge, existed in different degrees of "scientific plausibility" in the lore of natural history. Usually this knowledge was more "place sensitive" than the more abstract biological theories, but then the latter constituted only a part of natural history. Much of routine research in natural history required a whole package of situated knowledge, material practices, bodily skills, field experience, etc. Thus, the very activity of exploring a foreign land and appropriating the indigenous knowledge entailed the influx of hybrid knowledge that resisted the naturalists' efforts to categorize and discipline. In other words, it opened up a cultural borderland in which various strands of practice and knowledge mingled.

Was the scientific encounter asymmetrical? Perhaps, but the answer is not as simple as one might think. It is true that most of the Chinese involved in these scientific activities were not naturalists and, with a few exceptions, they did not continue scientific research after the association ended. Some of them became professional collectors and taxidermists, and a few would work for the museums in Shanghai and elsewhere. Most returned to lives as artisans, hunters, farmers, and laborers. If, however, we widen our perspective and see scientific activity as part and parcel of a broad exchange of cultural practices and productions, all of which were integral parts of the enterprise of natural history, we come to a more complex conclusion. Exchange occurred in multiple forms and in unexpected places (e.g., export art and visual representation of science, taste and techniques in horticulture, and folk knowledge in fieldwork). The issue also depends on what is designated as symmetrical (that is, what the categories of comparison are). Situated knowledge in fieldwork may be seen as the product of complex negotiations between naturalists and natives as well as between different knowledge traditions. It formed a vital component of the heterogeneous configuration of knowledge and cultural practice that was natural history. One may argue that since such knowledge and practice were products of encounters in cultural borderlands, it is not particularly helpful to insist

on calling them European or Western. Instead, they can be more fruitfully placed within the context of the global circulation of knowledge and cultural practices.

In any case, even if one is not ready to go that far, as historical investigators, we should not leave such conventional categories as East/West and Chinese/European unexamined. For these were not fixed entities, but products of boundary drawing and power negotiations among historical actors. Therefore, when historical actors employed such cognitive categories as Chinese and Western to classify themselves and particular cultural elements as opposed to others, we should ask how they defined these categories and how these categories became stabilized in a given historical context. We want to know why certain things came to be seen (and by whom) as Chinese or Western. We should exercise the same caution when we, as historians, label something in the past as Chinese or Asian or European or Western. All this is not to say that there have not been global hierarchies of social and cultural institutions and knowledge traditions. There have always been hierarchies of these sorts between (and within) societies. It is crucial to investigate how such hierarchies were established. Instead of accepting at face value the conventional view that the scientific elite in the European metropole was more competent and had more of a say in all matters in science, we should ask: why and how did it wield more resources and power than those in the colony or other societies in certifying and evaluating knowledge *in particular circumstances*? I emphasize "in particular circumstances" because, as I have argued throughout this essay, the institutional and intellectual hierarchy of knowledge production was not fixed, but was situational and could change according to particular contexts (although of course there were also certain general patterns).

5

Traditional historiography of science and imperialism leaves little room for appreciating how cultural encounters might have helped shape the practice and knowledge of science, especially the field sciences. But if we see the field sciences (including natural history) as heterogeneous and as wide-ranging as they actually were, new opportunities for inquiry open up. Knowledge production took place not only in European metropoles, but also in other parts of the world—on the spot, so to speak. And the people who participated in the process of knowledge-making often included the creoles and autochthons who brought with them their perspectives, traditions, and know-hows. Our study of Western naturalists in Qing China is both specific and general. Some of our observations are specific to the historical locus of Qing China. But many are applicable to science in cultural borderlands elsewhere. To better understand the history of science, therefore, it is crucial to have a broad view that takes in science in a global perspective as well as to pay attention to the detailed actions in cultural borderlands in a particular time and place.

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